Responses to the referee #3:

We thank the referee #3 very much for the constructive comments on our manuscript. The comments are valuable during the revision process and will further guide our research. We really appreciate that you give many specific and detailed suggestions, which help enhance our paper a lot. We have studied the comments carefully and revised the manuscript accordingly, which we hope will meet with your approval. The comments (bolded) and responses are fully addressed as follows.

This paper reports on an investigation of the effects of water level fluctuations in the Three Gorges Reservoir on a tributary bay on the Tangxi River, the focus being on a number of water quality parameters. The study is based on a numerical simulation using the width-averaged vertically two-dimensional model CE-QUAL-W2. It was conducted for the year 2017 and water quality data collected at the Tangxi River Bridge located 18 km upstream from the confluence was used for validation.

Authors' response: Thank you for your commentary. Below we present our responses to each comment.

Major comments

1. While the results address an important problem they are rather limited in scope. The paper could be enhanced, for example, with a discussion of how sensitive the results are to the model forcing, e.g. winds and air temperature. Are the distributions/variations in the water quality parameters driven solely by the water level fluctuations in the reservoir or do the forcings make a contribution?

Authors' response: Thank you for your suggestion. The aim of our paper is to study how a tributary bay was influenced by backwater jacking and intrusion from the main reservoir. The link between the main reservoir and its tributary bay is the hydrodynamic

condition, which is mostly affected by the water level fluctuations (Sha et al., 2015). So, we focused on the water level fluctuations in the main reservoir and its influence on the tributary bay in this manuscript.

We used the daily average data of multi-year on winds and air temperature as the boundary in our simulation. We have discussed the sensitivity of our results to the winds and air temperature at a new section in the revised manuscript.

We also have enhanced our paper in other aspects. For instance, we have added discussions with other tributaries in the results and discussion section. We also have added some references to support our study and added some details to improve the quality of this paper. We hope our efforts to enhance the paper can meet with your approval.

2. The model validation is limited to comparisons of water quality parameters at a single point: the Tangxi River Bridge. These measurements do not include measurements of currents so there is no validation of the circulation patterns shown in figure 5 or of the two-dimensional distribution of the water quality patterns. This should be commented on and ideally addressed somehow.

Authors' response: Thank you for your comment. We have tried our best to find the fundamental data, but only the data of water quality parameters in Tangxi River Bridge can be got at present. So, we used the data of Tangxi River Bridge to valid the model CE-QUAL-W2. Though the model validation was limited, many scholars have obtained good results by using it. Moreover, this model is mature and has been proved to perform well in simulating the hydrodynamics, water temperature and water quality of reservoirs and lakes. Therefore, we think our results and conclusions are credible. We also have added this information at the end of introduction section. We hope our explanations for this comment can get your understanding and support.

3. The title has some grammatical errors: "The hydrodynamic and environmental

characteristics of a tributary bay influenced by backwater jacking and intrusions from a main reservoir"

Authors' response: We have changed the title according to your suggestion.

4. The introduction should include a background discussion on what backwater jacking is and what intrusions from the main reservoir are and the conditions under which they occur. It does not have to be long.

Authors' response: We have added the meanings of backwater jacking and intrusion from the main reservoir and the conditions under which they occur in the revised manuscript as follows.

Backwater jacking occurs in tributaries when dams or other obstructions raise the surface of the water upstream from them. Intrusion is the process that the water from the mainstream intrudes into the tributaries.

5. The abstract is very long. Seems too long to me.

Authors' response: We have condensed the abstract in the revised manuscript.

6. Line 14. " ... is the key ...". Is it really true that this is the one an only key to solving eutrophication or is it one more several. I find it hard to believe that it is the only key to solving these problems. Similarly on line 74. Saying "is a key" seems more accurate.

Authors' response: We have changed "is the key" to "is a key" in Line 14.

7. The introduction is very focused on the Three Gorges Reservoir. The paper could be enhanced by adding a discussion of tributary bays in other parts of the world which would help put the work in a wider context.

Authors' response: Thank you for your suggestions. We have tried our best to find the

studies of tributary bays in other parts of the world, but the studies were few. However, we have added discussions of other tributary bays of the TGR in the revised manuscript. We hope our efforts to enhance the paper can meet with your approval.

8. Line 152. Here it is stated that the water density is affected by concentrations of solids (should be 'suspended solids') but equation (6) for the density is a function of temperature only – it does not depend on concentrations of suspended solids. Were these concentrations included in the model somehow? If so this should be explained. If not this should be made clear.

Authors' response: We are sorry that we made a mistake in this statement. The concentrations of suspended solids weren't included in the model. We have revised this sentence as follows.

Accurate hydrodynamic calculations require accurate water densities. The following equation of state relating the density to the water temperature was used in the model.

9. What shortwave absorption model was used in this study? A two- or three-band model, or otherwise? With what attenuation coefficients? Fixed or a function of suspended sediments? In parts of the domain (e.g. figure 5) the water is shallow at some times of the year. Does shortwave radiation reach the bottom? If so how is it handled. Does it reflect off the bottom or is that heat absorbed by the bottom potentially creating unstable stratification?

Authors' response: The shortwave absorption we used was according to Bears Law (Thomas and Scott, 2008). The attenuation coefficients in the model include the fraction absorbed at the water surface and the extinction coefficient. The values of them were 0.45 and 0.45 m^{-1} respectively.

As the content of suspended sediments was low in the research area, we didn't consider the suspended sediments in the simulation.

According to our study, the water depth was around 5 m in the upstream from May to September. Most of the shortwave radiation was absorbed by the water, only a small amount of the radiation reached the bottom. Due to the exponential decay of the shortwave radiation, we didn't distinguish the heating after the radiation reached the bottom of the tributary in the simulation.

As for the stratification, the small amount of radiation that reached the bottom of upstream could not cause the vertical convection problem and it had little effect on the stratification. We hope our explanations for this comment can meet with your approval.

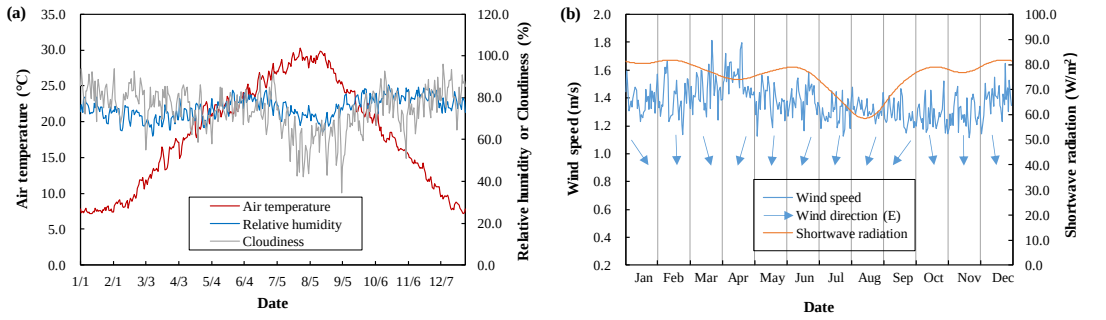
10. I suggest adding a figure showing some of the meteorological forcings: air temperature and wind in particular. The only information on winds and air temperature are the monthly averages in table 1. Why are averages enough? What was the temporal resolution of the forcings used to drive the model: hourly, daily? Were the monthly averaged values used to driving the model? If so why not more frequent values? No diurnal cycle in the forcing? Is the solar radiation in table 1 a combination of long and short wave radiation? These should be reported separately because shortwave radiation penetration penetrates into the water column and longwave radiation does not.

Authors' response: Thank you for your suggestion. Although the meteorological conditions were displayed in the form of monthly average value in the table 1, we used daily average data of multi-year in our simulation. We are sorry that this made you confused.

The diurnal cycle of our simulation last three years. We have added this information in our revised manuscript.

The solar radiation in table 1 was short wave solar radiation and we have specified this in the revised manuscript. The long wave atmospheric radiation was computed from air temperature and cloudiness.

According to your suggestion, we have replaced the table 1 with a figure of daily average values of meteorological data as follows.



11. Lines 192–193. The percentage error does not seem like a useful metric. A 25% error for a temperature of 4◦ is very different from a 25% error for a temperature of 20◦.

Authors' response: We agree with that the percentage error is not a useful metric, and we have used root mean squared error to reevaluate the model calculation accuracy. We have revised the description of the fitness between simulated values and measured values as follows.

The difference in T between the simulated value and the measured value was 0.6 - 4.7 ºC, and root mean squared error was 1.8 ºC. The difference in TP between the simulated value and the measured value was 0.004 - 0.03 mg/L, and root mean squared error was 0.01 mg/L. The difference in TN between the simulated value and the measured value was 0.02 - 0.26 mg/L, and root mean squared error was 0.16 mg/L. For NH_3-N, the difference between the simulated value and the measured value was 0.03 - 0.08 mg/L, root mean squared error was 0.06 mg/L, and the relative error was greater than 30%.

12. Figure 5. The left side of the region plotted in each panel varies with month of year. How is this left boundary determined? The ranges of *x* values plotted also varies from month to month which makes it a bit difficult to compare results from different months. The panels are also too small. I find them difficult to read. I

suggest full page figures with two columns, all using the same range of *x* values. Also, the red curve that is the boundary between Zone 1 and Zone 2 is difficult to see because there is not enough contrast with the colors of the other contour lines. They should be very different. In figures 7 and 9 the curve separating the zones is in black. It would be best to use the same color in all figures. Same comments for other similar figures.

Authors' response: Thank you for your suggestions.

The left boundary was determined by the water depth. We set the minimum number of activation layers in the simulation, and the corresponding water depth is 4 m. The simulation stopped when the water depth is less than 4 m, and the left boundary was determined.

If we put the figures into two columns, the figures will become too long and look not good. So, we still arranged the figures into three columns, and we also ensured the accuracy of the figures. We have output clearer figures in the revised manuscript. We have used the same range of x values and uniformed the color of boundary between Zone 1 and Zone 2 in black in the revised manuscript according to your suggestion. We hope our revisions for these figures can meet with your approval.

Minor comments

1. Line 9. "... by backwater ..." (delete 'the').

Authors' response: We have deleted 'the' in this sentence.

2. Line 10. "intrusions from the main reservoir". The main reservoir is not intruding into the bay, it is water from the main reservoir which is intruding.

Authors' response: We have changed 'of' to 'from' in this sentence.

3. Line 15. "... relevant to the water environment"

Authors' response: We have added 'the' in front of 'water environment'.

4. Line 17. "... by backwater jacking and intrusions from the ..."

Authors' response: We have changed 'of' to 'from' in this sentence.

5. Line 19. "... and water quality model ..."

Authors' response: We have added 'water' in front of 'quality model'.

6. Line 23. When the water level dropped where? In the main reservoir?

Authors' response: Yes, in the main reservoir. We have revised this sentence as follows.

The tributary bay was mainly affected by backwater jacking from the main reservoir when the water level of the main reservoir dropped and by intrusion from the main reservoir when the water level of the main reservoir rose.

7. Line 24. What is a 'quality concentration boundary'?

Authors' response: It is a boundary of the water quality and we have added 'water' in front of 'quality concentration boundary'.

8. Line 38. "200 m or even 300 m" is a bit redundant. If dams are 300 m high then it is not necessary to say they are over 200 m high.

Authors' response: We have deleted 'over 200 m' in this sentence.

9. Line 40. Delete 'However,' and 'the': "These dams block fish .... and change fish communities..."

Authors' response: We have deleted them.

10. Line 51. "... thus forming water areas ... to lakes known as a tributary bay"

Authors' response: We have revised this sentence as follows.

Backwater extends to some tributaries after the construction of dammed-river reservoirs, which causes the water depth to increase and the water velocity to slow in these tributaries, thus forming the water areas similar to lakes known as a tributary bay.

11. Line 90. "... to a rise or decline in chlorophyll content depending ...."

Authors' response: We have revised this sentence as follows.

Some scholars found that a rise in the water level may lead either to a rise or decline in the chlorophyll content, depending on the water cycle mode in the tributary.

12. Line 91. Do you mean 'Past studies have paid ..."? If you mean the present study (i.e. this paper) then the grammar is incorrect.

Authors' response: Yes, we mean the past studies. We have changed 'present' to 'past'.

13. Line 96. "by backwater jacking and intrusions from the main ..." This needs fixing in many places.

Authors' response: We have fixed the mistakes in the revised manuscript about this sentence.

14. Line 96. The sentence "How the .... tributary bay?" needs to be revised. Perhaps "There are many open questions regarding the functions of these types of systems: How does the operation of the main reservoir affect tributary bays?; How do hydrodynamic forces and the water environment of tributary bays respond to backwater jacking and the intrusion of water from the main reservoir?; What controls the water environment of tributary bays?"

Authors' response: Thank you for your positive and constructive suggestions. We have revised the sentences according to your suggestion.

15. Line 103. "... by backwater jacking and intrusions from the TGR ..."

Authors' response: We have changed 'of' to 'from' in this sentence.

16. Line 106. " and water quality ..."

Authors' response: We have added 'water' in front of 'quality model'.

17. Figure 2. The figure caption could be more informative, describing what is shown in each panel.

Authors' response: We have described each panel in the caption of Figure 2. We also have added descriptions in each panel of Figure 1. The new caption of Figure 1 is as follows.

Fig. 1. Research area and hydrologic system of the Tangxi River Basin. (a) The location of research area relative to China; (b) The location of research area relative to Chongqing; (c) Hydrologic system of research area.

18. Line 131. "The vertical two-dimensional ...W2 solves the width averaged equations and is appropriate from simulating flow in long narrow water bodies. It was adopted for ..."

Authors' response: We have revised this sentence as follows.

The vertical two-dimensional model CE-QUAL-W2 solves the width averaged equations and is appropriate for simulating flow in long narrow water bodies. It was adopted for the calculation of the hydrodynamic conditions, water temperature and water quality in the tributary bay.

19. Line 135. What density current? This is the first mention of a density current.

Authors' response: It's the density-driven current. We mentioned this to explain the

model can perform well in backwater intrusion issue.

20. Line 136. "... results using this ..."

Authors' response: We have deleted 'by' in this sentence.

21. Line 140. Delete 'listed'.

Authors' response: We have deleted 'listed'.

22. Lines 156–158. This information should appear directly below equations (1) - (5).

Authors' response: We have moved the explanations of each variable below equations (1) - (5).

23. Line 183. "... was used to ..."

Authors' response: We have corrected this sentence.

24. Line 200. What does "usually exhibits characteristics" mean? I do not understand this.

Authors' response: We are sorry that we missed a word 'complex'. The correct sentence is "…usually exhibits complex characteristics" and we have corrected this in the revised manuscript.

25. Line 215. How far away from the tributary bay was the meteorological data collected?

Authors' response: The weather station is about 19.7 km away from the tributary bay. We have added this information in the revised manuscript.

26. Line 216. " sources were calculated and included as inputs to the numerical

simulations"

Authors' response: We have revised this sentence as follows.

The meteorological conditions (Figure 4) of the Tangxi River and TGR were based on the data from Yunyang County weather station (19.7 km away from the tributary bay), and the pollution loads of point and non-point sources were calculated and included as inputs to the numerical simulations (Table 1).

27. Line 265. "... nutrient status of ..."

Authors' response: We have corrected this sentence.

28. Line 277. Correct grammar.

Authors' response: We have changed 'of' to 'from' in this sentence.

29. Line 278. Delete "With the water level fluctuation through the whole year"

Authors' response: We have deleted this.

30. Line 283. "... length of the backwater ..."

Authors' response: We have added 'the' in front of 'backwater' in this sentence.

31. Line 285. "... main reservoir was between 160 and 175 m and the ..."

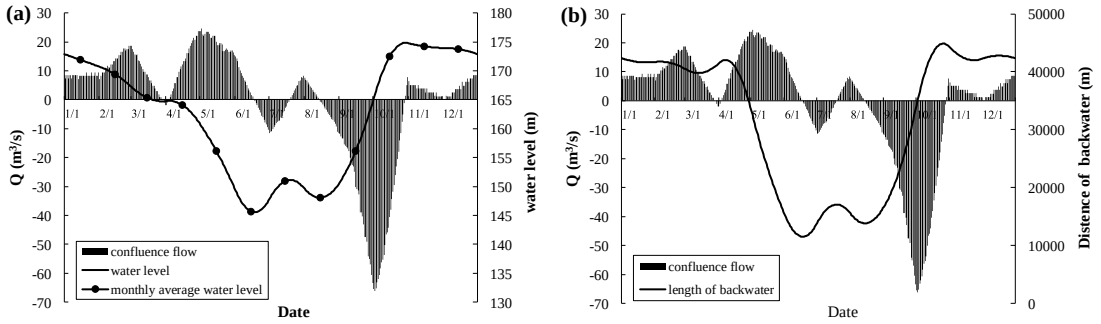
Authors' response: We have revised this sentence as follows.

During January to April and October to December, the water level of the main reservoir between 160 and 175 m and the backwater reached distances of 39.8 - 42.6 km from the confluence simultaneously.

32. Figure 4 caption. "The relationships among reservoir water level, length ....".

The caption should say what the curves are and what the filled in regions are.

Authors' response: Thank you for your suggestion. We have added the legend of fig.4 in the revised manuscript as follows.



33. Line 302. What is 'water from the tail'?

Authors' response: We have revised this sentence as follows.

In each month, the upstream water flowed along the surface of the tributary bay or sank to the bottom.

34. Line 316. What does 'directly flowed to the confluence' mean? Flowed along the surface? This should be clarified. Where is the confluence in the figure?

Authors' response: Yes, we meant the upstream water flowed along the surface. The confluence is the right end of the tributary bay in the figure. We have revised this sentence as follows.

From July to August, the upstream water of the tributary bay directly flowed to the confluence along the surface layer.

35. Figure 7. The red contours in the figure should be explained in the caption.

Authors' response: We have added the explanation of the red contours in the caption. The revised caption of Figure 7 is shown as follows.

Fig. 7. The vertical two-dimensional distribution of water temperature in different months. The black curve in the figure is the boundary between Zone 1 and Zone 2. The brown curves with arrows are streamlines.

36. Figure 9. Revise caption: "Distribution of COD ...".

Authors' response: We have revised the caption of Figure 9 and we also have revised the same question in Fig.10 - Fig.12.

37. Line 462. "... was generally higher ..." (it was not higher in every month).

Authors' response: We have added 'generally' in front of 'higher' in this sentence.

38. Lines 506. I don't understand what the authors are trying to say here: "brought serve vertical"

Authors' response: We are sorry that this sentence made you confused, and we have deleted this sentence in the revised manuscript.

39. Line 507. What is meant by "could contrapuntally be proposed"?

Authors' response: We are sorry we used an inappropriate word 'brought' and we have deleted it in the revised manuscript.

References

Sha, Y., Wei, Y., Li, W., Fan, J. and Cheng, C.: Artificial tide generation and its effects on the water environment in the backwater of Three Gorges Reservoir, Journal of Hydrology, 528, 230-237, https://doi.org/10.1016/j.jhydrol.2015.06.020, 2015.

Thomas, M. C. and Scott A. W.: CE-QUAL-W2: A two-dimensional laterally averaged hydrodynamic and water quality model, Version 3.6, Department of Civil and Environmental Engineering, Portland State University, Portland, 2008.